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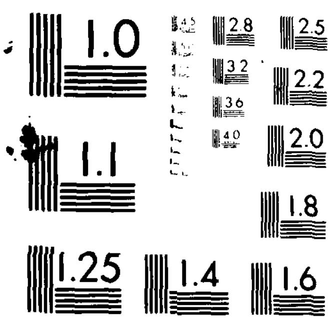

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Research and Development Technical Report

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3.2 MILLIMETER WAVE TRANSMITTER TUBE

Jon A. Davis

HUGHES AIRCRAFT COMPANY
Electron Dynamics Division
3100 West Lomita Boulevard
Torrance, California 90509

December 1981

Interim Report for Period 1 June 1981 – 30 September 1981

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

During this period the beam tester was successfully re-tested with the original design magnets, which were saturated to 5100 Gauss. Because of the stronger field and, presumably, less radial field on axis because of the more uniform nature of saturated magnets, the beam transmission was dramatically improved from 77% to 96%. The successful operation of the beam tester has demonstrated that the PPM focusing scheme will provide excellent beam focusing of the 982H TWT.

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1.0 INTRODUCTION

The objective of this program is to develop a 100 watt, 50 percent duty, 93.75 GHz (3.2 millimeter) coupled cavity TWT. The TWT will be PPM focused, liquid cooled, and aperture gridded for beam modulation. The program consists of performing the necessary design, building and testing of a beam tester, and building and testing one (1) experimental RF tube. The performance requirements are shown in Table 1-1.

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TABLE 1-1

982H OPERATING CHARACTERISTICS

RF Characteristics	
Power Output	100 Watts
Center Frequency	93.75 GHz
Instantaneous Bandwidth	2.0 GHz
Gain	50 dB
Pulse Length	25 μsec (max.)
PRF	20 kHz (max.)
Duty Cycle	50%
Electrical Characteristics	
Beam Voltage	-22 kV ± 2 kV
Beam Current	.0907A (nominal)
Body Voltage	Ground
Body Current	.020A (max.)
Collector Voltage	-12 kV ± 2 kV
Collector Current	.0907A
Grid Pulse Voltage	+1100 V
Grid Bias Voltage	-350 V
Grid Current	.001 A
Heater Voltage	6.0 V
Heater Current	1.0 A
Vac Ion Pump Voltage	3.0 kV ± .3 kV
Vac Ion Pump Current	<10 μA
Mechanical Characteristics	
Cooling	Liquid
Focusing	PPM
Weight	12-14 lbs
Size	4.0" Dia. X 16" Long

2.0 BEAM TESTER

The beam tester now has 96% beam transmission, up sharply from the 77% previously obtained. This successfully proves that the PPM design is effective. The reduced body current resulted from using the original design magnets, as shown in Figure 1, but with magnets saturated to 5100 G, as opposed to the 4200 G that the SmCo magnets were originally de-Gaussed to. The fields are stronger and more uniform (no radial field on axis) with saturated SmCo.

The magnets at each end are thicker than those elsewhere, in order to compensate for the added fringing fields from the iron pole pieces. Unfortunately, hind sight and closer analysis has shown that increasing the field at the ends exacerbates end effects, in that the fields at the third magnets from the ends are reduced, and those at the second magnets are increased (Figure 2).

The end magnets can be adjusted in order to reduce the external field and the end effects. This adjustment of the end magnets was necessary to achieve the good beam transmission.

The grid characteristic curve of the beam tester is shown in Figure 3. The tube focused best at the design voltage of 22 kV, with a cathode current of 89 mA. The grid drive was 900 V, and at -300 V grid bias voltage the beam was well cut-off.

The cathode activity curve is shown in Figure 4. $E_F = 6.5$ V is the chosen value, where the cathode is space charge limited.

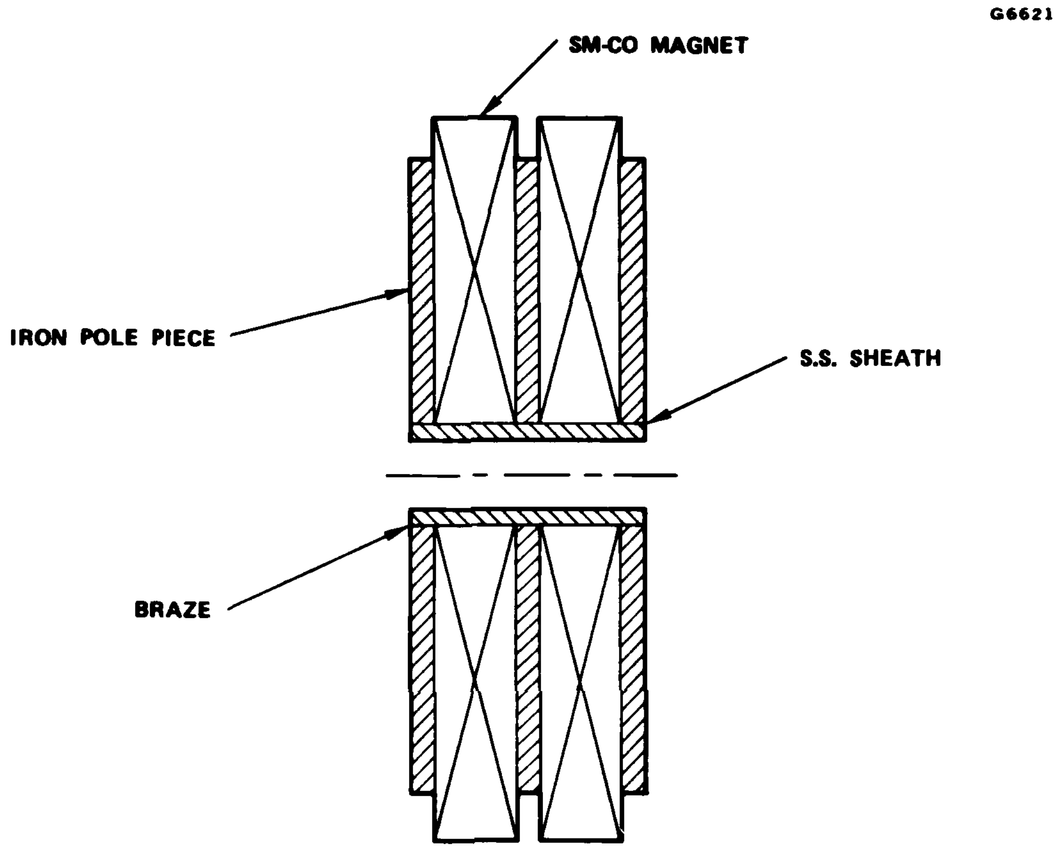


Figure 1 Magnet design.

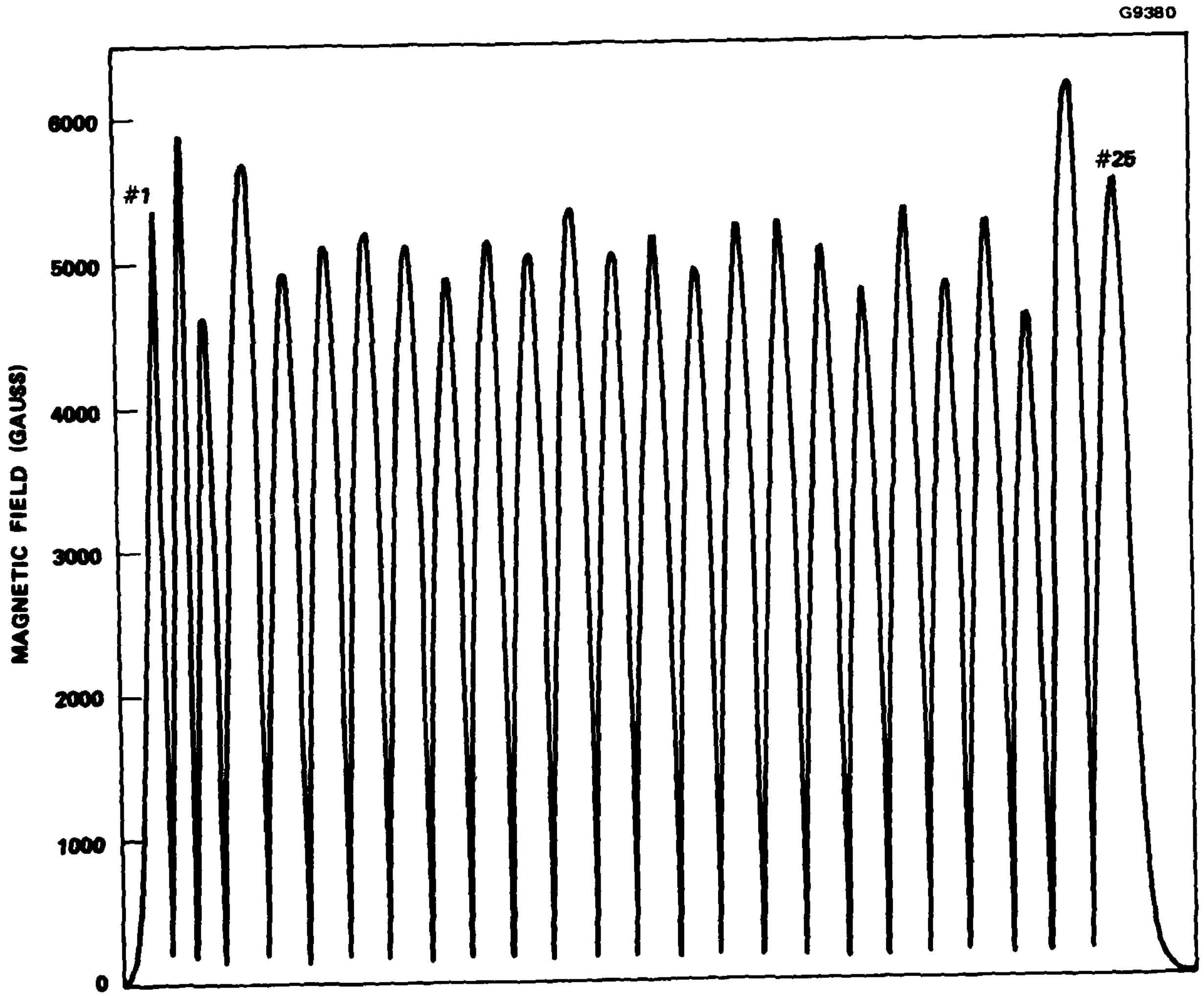


Figure 2   Field plot of saturated magnets.

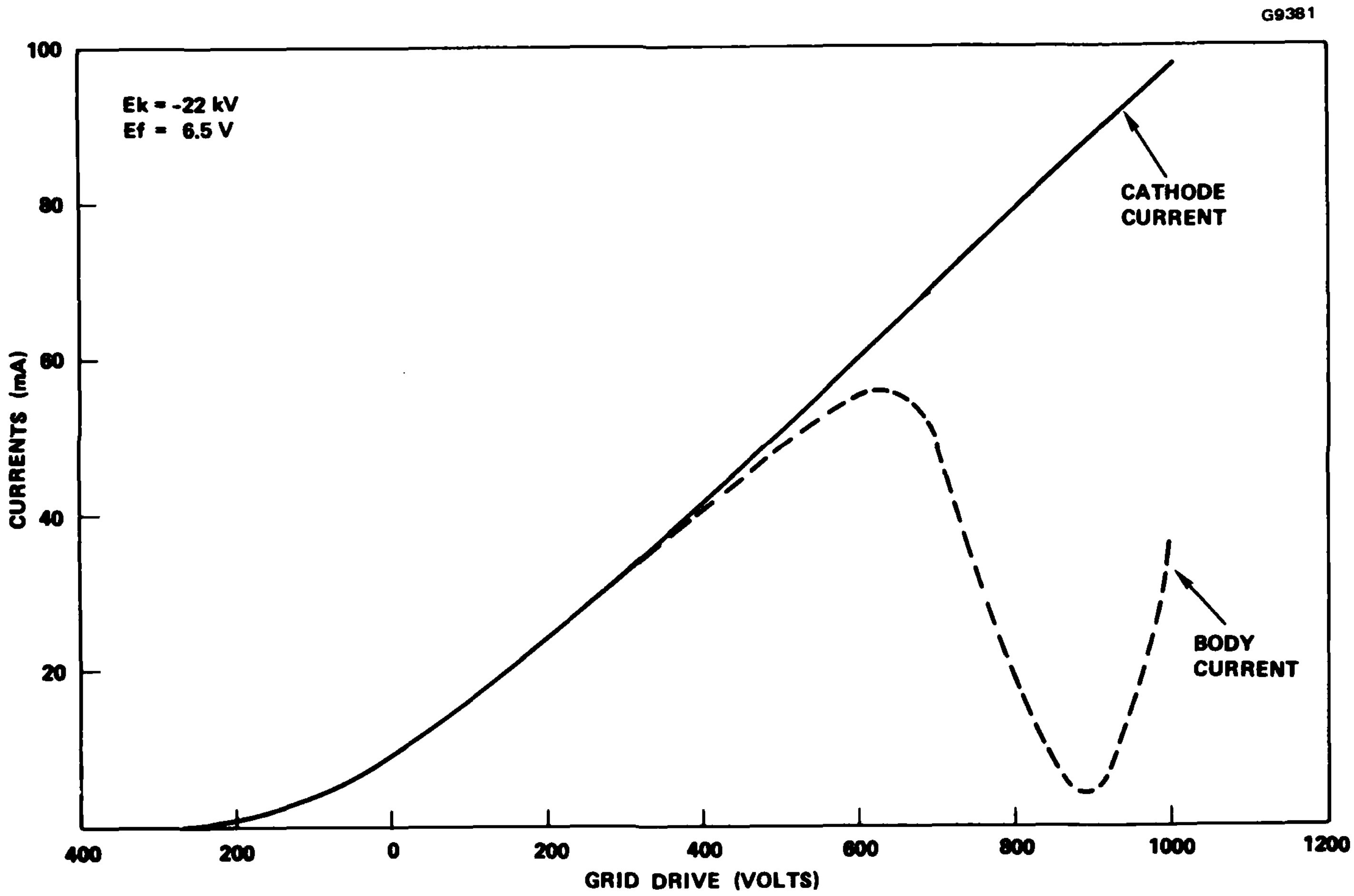


Figure 3 Grid characteristic curve.

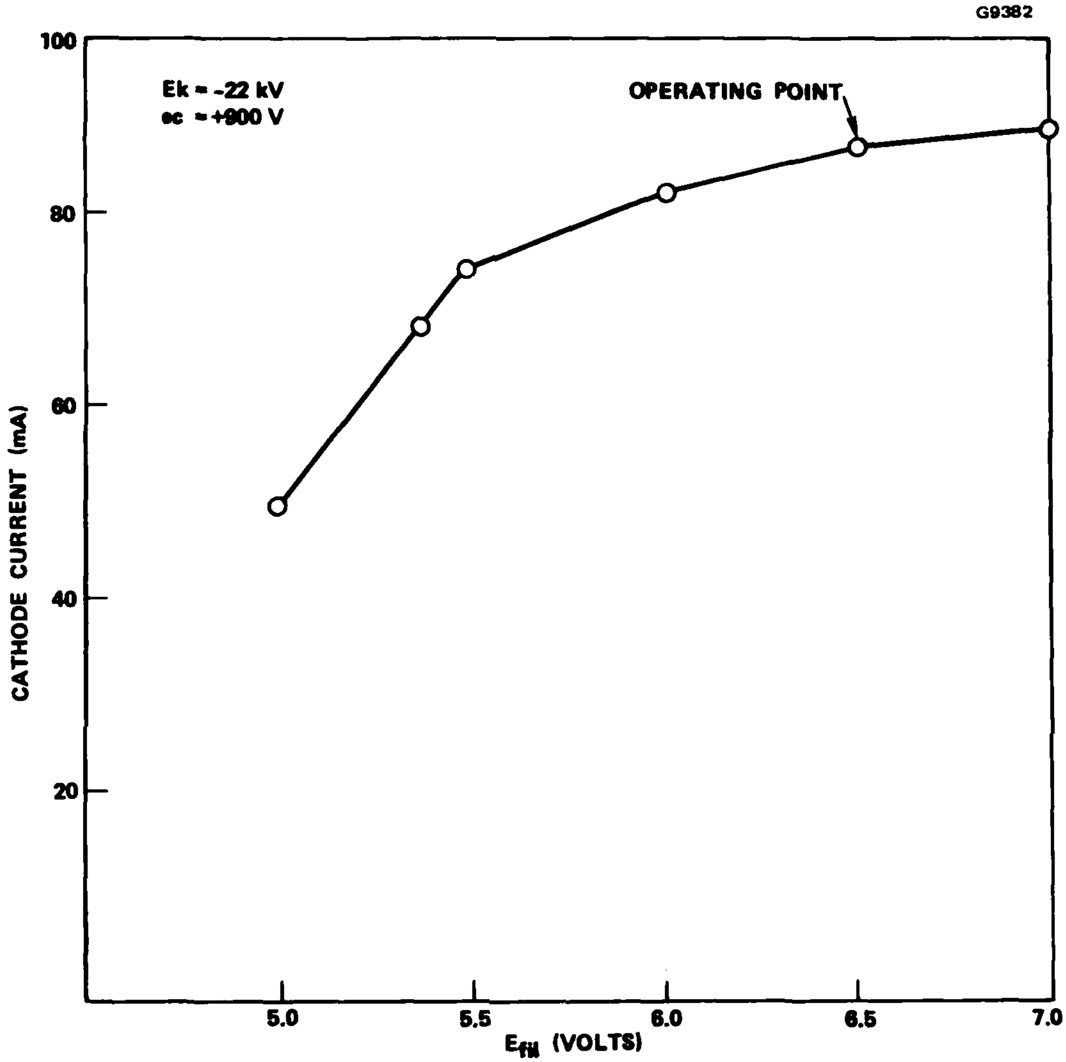
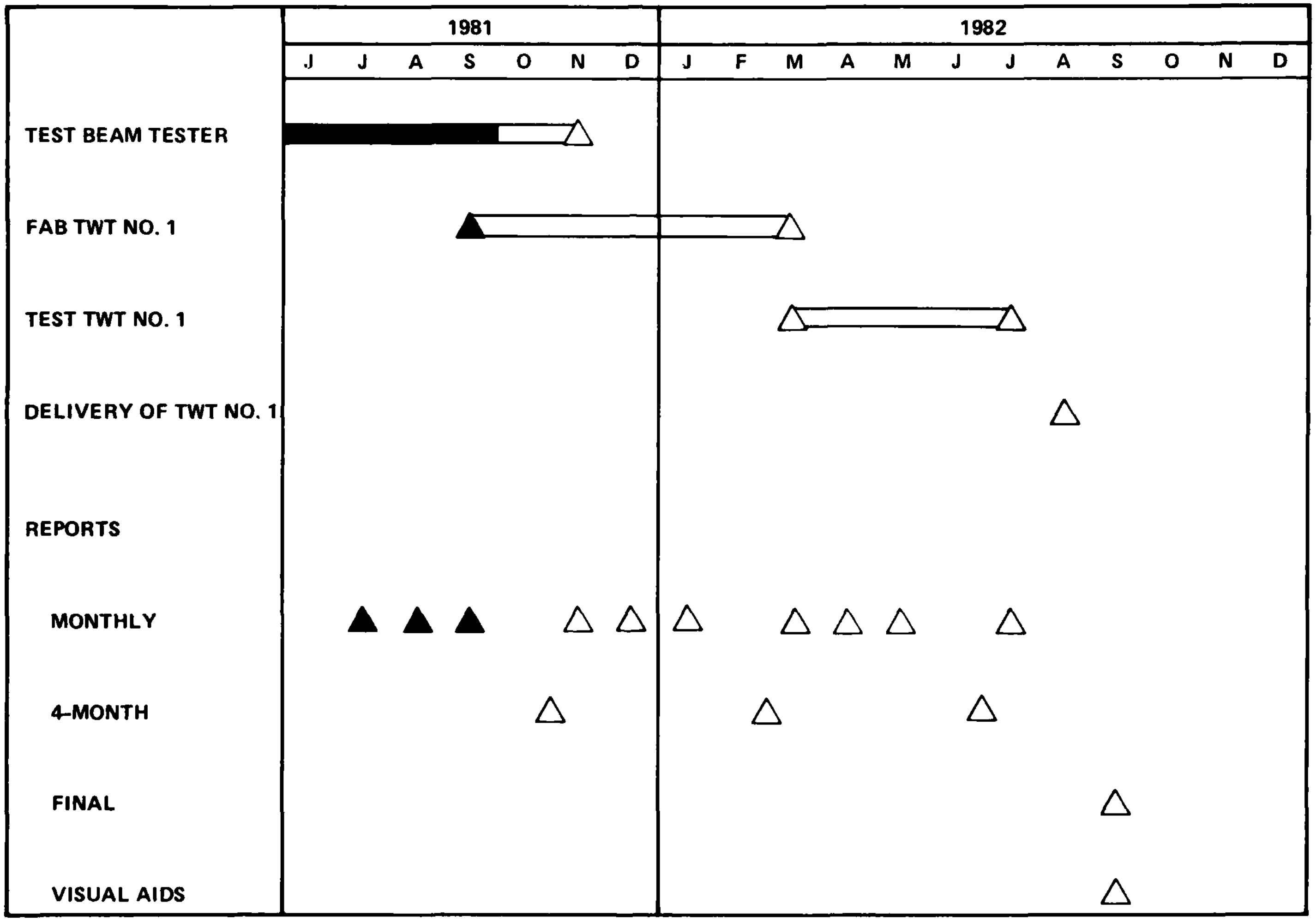


Figure 4 Cathode activity.

3.0 TWT STATUS

There are still a few parts needed to be fabricated for the TWT. These include miscellaneous rf cavity part for matching into the waveguides and severs, and the velocity taper parts. Also, the gun had had some design changes based on experience gained from building the gun for the beam tester, and these new parts are on order. We expect all parts by January, and will begin circuit assembly then. The collector, the gun and collector pole pieces, and vacuum sheath with brazed on pole pieces are all completed.

982H PROGRAM SCHEDULE
REVISED AUGUST 1981



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Code F-14
Naval Surface Weapons Center
001 Dahlgren, VA 22448

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Radar and Instrumentation
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Georgia Institute of Technology
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(Murray Rosenbluth)
Dover, NJ 07801

Dr. Mac Gregor
Shared Applications, Inc.
611 Church Street
001 Ann Arbor, MI

Commander
AARADCOM
Picatinny Arsenal
Attn: DRDAR-SCF-IM
(Mr. O'Brian)
001 Dover, NJ 07801

Commander
AARADCOM
Picatinny Arsenal
Attn: DRDAR-SCF-IM
(Mr. Yarosh)
001 Dover, NJ 07801

Commander
AARADCOM
Picatinny Arsenal
DRDAR-SCF-IM
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001 Dover, NJ 07801

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Universal Computer Applications
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